

Fabrication of Highly Ordered Structures Using Anodic Porous Alumina

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The fabrication of ordered fine patterns of nanometer dimensions is of growing importance for preparing various types of nanometer-scale devices, such as electronic, optoelectronic and magnetic devices. For preparing the fine structures, process based on self-organization of materials is promising because it yields fine structures of nanometer dimensions over large areas which is difficult to achieve with conventional lithographic techniques.

Anodic porous alumina, which is formed by the anodization of Al in an appropriate acid solution, is a typical self-organized structure with an ordered array of uniform-sized pores. This material is useful as a starting structure for the fabrication of several kinds of nanodevices because of its ordered hole array structure with high aspect ratios. In the present work, we describe the fabrication of mosaic structure in anodic porous alumina which is composed of an ordered array of two kinds of metals in anodic porous alumina membranes.

In the previous work, we reported the fabrication process of ideally ordered anodic porous alumina using pretextured Al, where the shallow concave formed by nanoindentation initiates the development of the pores during the anodization[1]. By modifying this technique, selective deposition of metal into the holes of anodic porous alumina could be accomplished.

Figure 1 shows the SEM image of a typical mosaic structure in anodic porous alumina obtained using the present process. In this sample, Au and Ni were electrochemically deposited selectively, and formed an ordered mosaic structure in anodic porous alumina. For this structure, pretexturing of Al was carried out

using a mold of SiC which has an array of convexes of nanometer dimensions in a graphite lattice[2]. The pattern of the SiC mold was transferred to an Al sheet using the nanoindentation process, resulting in the negative structure of the mold of the array of concaves on Al. The anodization of Al was conducted under constant voltage condition in an oxalic acid solution. The anodic oxide membrane prepared using pretexturing of graphite lattice has an array of holes with periodically modulated structure[2], which can be used for the selective deposition of metals into the holes.

This new type of process will be useful for the preparation of several kinds of functional electrodes or chemical sensors.

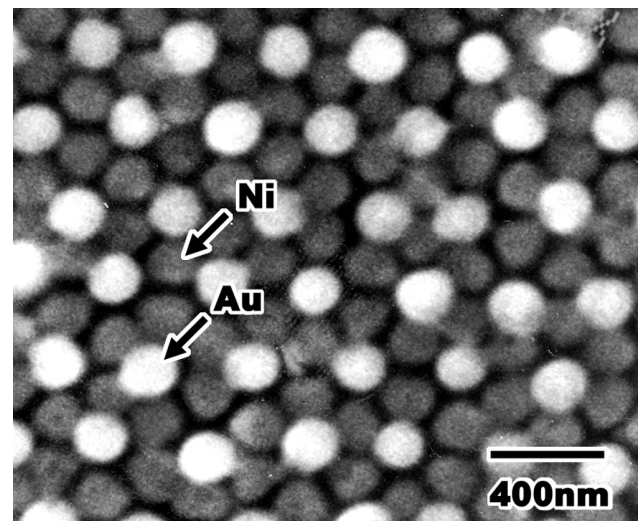


Figure 1 SEM view of mosaic structure composed of Au/Ni cylinders obtained after removal of alumina.

- 1) H. Masuda, H. Yamada, M. Satoh, H. Asoh, M. Nakao, and T. Tamamura, *Appl. Phys. Lett.*, **71**, 2770 (1997).
- 2) H. Masuda, M. Yotsuya, M. Nakao, A. Yokoo, T. Tamamura, and K. Nishio, *Appl. Phys. Lett.*, **78**, 826 (2001)